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Some points to consider as we write our reports and define future games, listed in no particular order.

Limited Time Series

We have only looked at a single 5 year sequence. That sequence began with 2 critical years (following several additional dry years). In 1993 (a wet year), fish stocks were at very low levels due to the drought and required an unusual amount of protection. Perhaps only 1994 and 1995 could be considered relatively typical. Thus, our conclusions are based upon a very shaky foundation. *I recommend that we move to a longer gaming sequence, once we have worked out some additional kinks in our gaming method (see below).* Beyond that, we could look at randomizing our hydro or biological data, but I think that we can wait on that for a while.

Improvements in Daily Sim Model

The daily simulation model is an extremely useful tool. However, the model has several limitations that appear to be relatively easy to fix (there may be others):

- Annual deliveries. The model attempts to export water at very high rates, even in years in which historical demand did not exist for that water. This feature is a useful reminder that, under the present rules, exports could increase dramatically during wet years. However, when looking at near-current conditions, the high deliveries in the model force the EWA to buy down phantom exports and exaggerate the difficulty in making the EWA work.
- Accounting. The model does not perform a very thorough accounting of operations. This can lead to distortions and forces us to keep a separate tally of EWA and Project actions. We may decide that including the accounting within the model is not worth the effort. However, for the record, here are the kinds of things that appear to be left out:
  - EWA water is not tracked separately in the model. We need to have a tally of EWA storage in every reservoir.
  - EWA water in groundwater storage is not tracked within the model.
  - Delta island storage, whether stand-alone or interconnected to the export pumps is not tracked within the model.
  - Storage in San Luis does not reflect south of Delta water purchases by the EWA. Therefore, San Luis storage frequently will drop below actual projected levels. This makes EWA operations appear more harmful to the Projects than they really are and can make it more difficult to fill San Luis the next year than in reality.
  - The model should be able to account for changes in Project deliveries compared to the baseline. There are a number of scenarios in which the Projects will be able to increase Project deliveries compared to the baseline.
- Fish take analysis. Many actions take place during only a portion of a month and target periods of highest (or lowest) fish take. However, the model averages diversions and take over the entire month, thereby minimizing the benefits of real-time management. The model should average and compute fish take by week, not by month. Also, analysis section does not account for changes in the take numbers which were assumed by the biologists. For example, higher flows caused by the EWA were assumed to shift Delta smelt downstream during May? of 1993? Therefore, we assumed that very high take densities of smelt in the historical record would not recur. Therefore, we did not make export reductions. But the model did not make that adjustment and the post game analysis showed enormous take during this month.
- Automate game runs.

Improving Gaming Efficiency

Our gaming procedure remains unnecessarily inefficient. When we are only able to game 2-3 years per day, we drastically limit the number of scenarios that we can look at. If we want to be able to run a large number of additional scenarios (including years we have yet to simulate), we may wish to consider some of the following ideas:

- Don't repeat real-time biological analysis each game. As long as we continue to use historic data, then the biological problems and concerns are unlikely to change very much from game to game. If we do the analysis in detail once, we should be able to reuse that analysis each game. The main exceptions will occur when changed antecedent conditions changes our biological assessment (e.g., increased outflow due to EWA in a previous month reduces concern over Delta smelt take).
- Use previous games as a baseline for closely related games. When running games that are closely related, there may be no need to completely rerun the game from scratch. For example, we probably could have run Game 5 as a simple variation on Game 4. EWA assets were the same as Game 4, except that we had an extra $10 million per year and could no longer rely upon the in-Delta AFRP flows. Therefore, instead of working from a DWRSIM base run, we could have used the Game 4 results as our base run and made only those changes necessitated by the change in assets. This would have greatly simplified our job.
- To extend this concept, once we are aware of the biological issues, we should be able to automate much of our games. For example, if we know the months (or weeks) in which we wish to keep pumping down to 5 kcfs and the months (or weeks) in which we are willing to allow E/I variances, then we could program these conditions into the daily model. We would then no longer need to spend time on these measures and could focus on other decisions, such as water purchases, flow releases, etc. We could even change infrastructure and see how our decisions on flow reductions and increases would hold up.

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- Post Process closely related games. Similarly, we could have simply analyzed the April – May period of Game 4 in order to estimate the amount of additional resources that would have been required to compensate for the elimination of the in-Delta AFRP flows.

Opportunity Costs

One of the consequences of putting an EWA with a limited budget is to force consideration of opportunity costs. That is, the EWA is asked to provide the greatest degree of protection and enhancement possible per dollar invested. In general, the greater the number of opportunities for investing in environmental investment, the greater the return on investment. One major limitation we have imposed upon ourselves in the gaming is to allow EWA assets to be invested only in the acquisition, transportation, and storage of water. For this limited universe of investment opportunities, we can presumably come up with some sort of optimum investment pattern. However, we also need to consider the possible advantages of allowing some interacation between the EWA assets and the ERP Program. If land purchase and restoration is more highly leveraged, dollar for dollar, than the least useful export reductions, then we should be transferring money out of the EWA and into habitat. Similarly, if the export reduction program is paying bigger dividends than habitat, we should shift money the other way.

As an example of how connecting EWA and ERP budgets might cause us to rethink EWA operations, consider the way we treated 1993 during Game 2. In that year, a wet year, we expended on the order of $40 million of EWA assets on export reductions during a period of very high flows. Were the fish saved worth $40 million? Certainly, if the EWA is limited to purchasing water for export reductions. But if EWA can be used to purchase other environmental benefits, then the picture is more cloudy. For this money, the EWA could have purchased 10 -20,000 acres of land in the Delta,[1] or purchased numerous screens, our bought 250,000 acre-feet of water upstream to boost instream flows. Was it still worth it? Maybe so, given that this was the first wet year after a long drought. Maybe not. But the point remains valid, either way. The EWA works best if it is not isolated from other environmental programs, but is treated more as one of many places in which to invest environmental money.

Wet Year/Dry Year Protection

Most of us originally believed that the EWA would expend a disproportionate amount of resources in dry years, while accumulating resources during wet years. This was not the case during Game 2 – the end of Stage 1. We actually accumulated assets during the dry years and spent them during the wet years. Why? Most of the environmental actions taken during this game were export reductions during sensitive periods. Since exports were very low during the drought years of 1991 and 1992, the cost of reducing exports was low. Meanwhile, the EWA had a few opportunities to divert water and was able to buy some cheap water. During 1993, the stakes rose by an order of magnitude. The EWA was able to divert more water for itself, but was also forced to spend enormous amounts of water and money to bring down exports from 15 kcfs to a level considered safe by the biologists. The year 1993 may have been an anomoly in that historical stocks were very low so that the biologists felt compelled to protect fish despite relatively low fish densities at the pumps. Nevertheless, it raises fundamental questions about EWA priorities and the distribution of property:

- If environmental protection is mainly a matter of reducing already low export levels in dry years at low cost, but dramatically reducing spring export levels in wetter years (at high cost), then the mismatch in needs between EWA and the Projects provides an opportunity to restructure EWA assets and strategies. For example, EWA might strike a deal with the Projects to supply dry year water to the Projects. In return, the Projects would deliver double or triple that amount of water to EWA in below normal, above normal, and wet years. In this way, EWA can effectively transfer unneeded dry year assets to the wetter years when they are most needed.
- Another way to accomplish this transfer of assets is to give the EWA a larger share of new export capacity, thereby reducing the cost of reducing pumping and allowing the EWA to recoup water debts more readily. This approach is recommended elsewhere in this paper.
- Alternatively, if dry years are the greater problem, then we need to emphasize strategies that transfer wet year assets to the dry years. That means storing up water and building up financial reserves during wet years for use in dry years. Pursuit of this strategy would mean:

    - Accepting somewhat greater levels of take during wet years under the assumption that higher flows will more than compensate for additional take. In this way, we can spend less and accumulate more water.
    - Using more money and more water to enhance flows during dry years
    - Develop as much storage as possible so that storage can be held from wet years to dry years. Long-term EWA storage assets currently are limited to 400 kaf of groundwater storage and 50 kaf of surface storage – not enough to do all that much during a long-term drought. This is probably all that we can look forward to in Stage 1. However, the need for more EWA storage might be incoporated into later stages.
    - Develop risk management strategies. For example: Enter a future's market (if one existed). In this type of market, the EWA would buy an option for water to be delivered the next year at an agreed price (before we know what kind of year it will be). The cost of the option and the cost of the water in the option would incorporate the risks, as seen by the seller. Then, if next year is wet, the option need not be exercised (and the EWA is only out the option cost). If the next year is dry, then EWA can exercise its option at a bargain price and the seller is on the hook to provide the water at a loss. We need to look into this in more detail. This type of future market exists in practically all arenas <u>other</u> than water. It would be a valuable tool for the EWA and for other water users as well.

[1] For example, we might buy Delta islands, picking up the following benefits: habitat, reduced TOC loading, reduced island entrainment, and EWA water (via reduced ET).

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Synergies

One of the major advantages of an EWA which controls a network of assets is that such an agency can take advantages of differences in the value in time and space, just the way other water agencies do. For example, when the value of reduced pumping is high, the EWA can reduce exports. When the disvalue of exports is low, then the EWA can increase exports. Indeed, by taking advantage of time and geographic differentials in the value of changed operations, the EWA is able to reuse the same water more than once to provide multiple benefits. Moreover, it can shift resources around to bolster weak points in the system. For example, the EWA could purchase water on the San Joaquin system to improve fall attraction flows, export and trade that water for water in Shasta, then release the water from Shasta (this assumes that the optimal fall flow patterns do not completely coincide on these two rivers) later in the fall, export the water, then sell the water and recoup the original cash investment. If the improvements due to the increased upstream flows outweigh the damage caused by the export of this water, then the EWA was able to generate benefits for essentially at low cost. In this sense, the EWA might be seen as a very efficient catalyst – able to make shifts in operations that have always been possible, but which do not occur because they cost extra money or increase risk to water users.

EWA Debt and Collateral

The EWA has the right, in the games, to take on storage debt, provided that it has adequate collateral to assure timely payback to the Projects. This is a very useful tool for the EWA, but we have oversimplified the issue in the gaming.

In Game 2 in 1993, the EWA took on enormous amounts of debt in San Luis in order to curtail pumping during the spring. The debt was paid off before the end of the summer with some groundwater pumping (120 kaf), some extra Delta pumping (?), some south of Delta purchases (100 kaf), and by moving 235 kaf of storage and purchases from north of the Delta to SLR. We even had a few additional tools we could have thrown at the problem. We might have asked for demand shifting from MWD to allow delayed payback. We might have shifted water from Shasta and Oroville etc. into San Luis during July and August (thus moving the debt upstream). We also might have relaxed additional environmental standards (assuming we had the authority to do so) to generate more export water.

Nevertheless, I am sure that the Projects would be very nervous about allowing this kind of a hole to be created in San Luis Reservoir, based upon the kinds of committed by the EWA. What would have happened if the spot purchase had fallen through or someone had protested shifting the EWA water from north of Delta to SLR? What if Kern or Santa Clara had refused the EWA access to groundwater pumping? If things were to go badly, the EWA's payback of SLR water might have been delayed past the SLR lowpoint, in which case contractors would have received reduced deliveries right at the end of the growing season. Thus, I believe, the value of collateral must be discounted to account for possibility that it cannot be delivered in a timely fashion. If the market is unreliable (as is the case now), then a commitment by the EWA to purchase and deliver water by a date certain must be heavily discounted. If the regulatory hoops required to move water from north of Delta to the export areas create uncertainty, then water owned by the EWA upstream must be discounted. This is not to say that EWA should only be allowed to act if it has water sitting in surface storage south of the Delta. But I do assert that the creation of debt by the EWA can proceed only if the EWA can assure the contractors that operations of the EWA will not put them at risk.

This implies that we need to take a second look at the reliability and feasibility of the various EWA tools. The game should be modified to reflect the actual constraints that may govern the various tools. For example:

- Markets. Will a spot market exist that will allow the EWA to purchase water virtually instantaneously? Such markets exist in other resource areas (power, oil, etc.), but are not reliable yet for water in California. What regulatory process will the EWA need to go through for purchased water? Will the process be efficient enough to allow use of the water within a few months of purchase? Can upstream purchases be delivered in a short-term pulse (as was done in July of 1993)? Or must they be delivered over a longer period (e.g., via reduced diversions by local agricultural districts).
- Demand Shifting. Will demand shifting arrangements with MWD be available every year? At what volume?
- Groundwater deposits/ extractions. Will extraction capability exist in all years? When is competition likely to be the highest? Can EWA purchase high priority access to extraction capacity?
- Relaxations. Will the EWA be able to grant E/I relaxations with high certainty, or are they likely to be vetoed by the SWRCB or other regulatory agency? If their ability to grant variances is unreliable, then the EWA cannot rely upon future relaxations to pay off a debt to the Projects.
- Delta storage. Water quality concerns continue to be raised about Delta storage, if these concerns turn out to be valid, the EWA may be more constrained in its use of Delta storage (though I believe this problem can be worked out as discussed below).

These kinds of considerations push us in certain directions, if we believe (as I do) that the ability to contract debt is crucial for the EWA. The common thread is reliability. The EWA must seek high reliability in its water purchases. This implies either purchases from south of the Delta, or long-term agreements. The EWA should also place a high priority on high priority access to storage and storage extraction capability south of the Delta. Thus, for example, the value of groundwater to the EWA may have been underrated thus far, because the reliability value of real water in accessible storage has not been a factor in the games to date.

To the extent that EWA collateral is not firm, it must be discounted. This means that the EWA may not be allowed to take on large debts, or that the EWA may be forced to pay a premium (i.e., greater than 1:1 payback) for borrowing.

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EWA Impact on the Transfer Market

In practical terms, the EWA will alter reservoir release and export patterns to improve environmental conditions and reduce damage. The ability to grant variances to the E/I ratio actually represents an increase in system flexibility attributable to the EWA (as would the ability to vary other standards). However, in most other respects, the EWA is likely to reduce system flexibility by reducing the remaining discretion available to Project operators and water purchasers to increase pumping. The basic operating tenet of the EWA is "no impacts on the Projects" so the Projects will not be affected by reduced flexibility. However, agencies attempting to move water through the Delta could be impacted by the reduced pumping windows left remaining for moving water through the Delta.

During dry years, pumping capacity remains available, though water transfers may be required to pay transfer taxes of 35% to satisfy the E/I standards. In the wetter years, demands will drop and deliveries rise, reducing the need for water transfers. In middling years, there might be problems. In these years, the Projects will be pumping at relatively high levels during the summer and fall, while the EWA may be moving large amounts of water through the Delta to pay off debts incurred during the spring and to build up storage in San Luis. Additional analysis is needed to determine whether the EWA is likely to constrain the markets. If the EWA is determined to be constraining markets, then a few responses are possible. First, the EWA might be forced to share surplus Project capacity with other water purchasers. Second, the expansion of pumping capacity at Banks will create new flexibility that may eliminate the bottleneck.

Environmental Constraints and the EWA

During Game 2, the EWA was somewhat hampered in its ability to fill Delta island storage by environmental regulations. During this game, Delta storage could not be filled on several occasions, despite opportunities and low impacts. But the operating rules for Delta storage were developed under the assumption that the project would develop yield for water users. If, instead, the project is devoted to environmental enhancement and is under the control of environmental managers, the need for very rigid standards may require reconsideration. The same can be said about other environmental constraints which, when imposed upon water projects make good sense, but which could become an unneeded complication for the EWA. In this category might fall the AFRP standards and the X2 standard. I am not saying that these standards should be relaxed, but that we may wish to consider giving the EWA some flexibility to modify these standards in order to improve environmental protection (as we have examined with the E/I relaxations).

Feedbacks to Deal with Improved Infrastructure and Increased Future Demands

Gaming to date indicates that the Projects are highly constrained in dry years, but are relatively unconstrained in wet years. Thus, new infrastructure (increased export capacity, storage) will allow some increases in exports during dry years, but major increases in exports during wet years. These increases in exports could lead to increased impacts, unless constrained by regulations or unless the EWA is given enough new resources to compensate.

The same is true of future demand. During wet years, Project deliveries are not constrained by infrastructure, but by limited demand. As system demand increases, normal and wet year diversions will also increase, leading to more environmental damage. The CALFED efficiency program may be able to slow the growth in demand. However, for safety, there should be some feedback mechanism to assure that environmental conditions do not deteriorate or time due to increased demands.

I believe that both of these objectives might be satisfied by defining sharing formulas for new export and storage capacity which assure that EWA capacities grow automatically as infrastructure grows and demand grows. One possible function is discussed in the next section.

Distributing Export Capacity Between EWA and the Projects

The games to date have demonstrated the utility of export capacity controlled by the EWA. Combined with storage and the ability to vary the E/I ratio, export capacity give the EWA to generate large amounts of low cost, low impact, high value water. Indeed, Games 4 and 5 demonstrate clearly that, without adequate access to export capability, south of Delta storage is relatively worthless. In both Games 4 and 5, the EWA was unable to put a single drop of water into groundwater storage and had to rely almost exclusively upon water purchases to generate environmental benefits.

Just as important, if the Projects gain control over all new export capacity at Banks and in the Delta Islands, the risk to EWA assets and the environment rises to unacceptable levels. The reason is that major take events frequently take place during high flow periods in the spring. If the Projects are able to pump, not at 10.3 kcfs, but at 15 kcfs or even 21 kcfs (using Delta storage intakes), then the cost of reducing export pumping to environmentally protective levels quickly becomes prohibitive. For example, reducing the export pumps from 10 kcfs to 5 kcfs costs the EWA 10 kaf/day. But reducing exports from 15 kcfs to 5 kcfs costs the EWA 20 kaf/day, a doubling of the EWA cost. Over several weeks, this difference can amount to enormous amounts of water. Moreover, without guaranteed access to the export pumps, the EWA will have a difficult time paying back this amount of water through increased pumping. Thus, the EWA is forced to rely very heavily upon markets. In turn, support for market access by EWA could collapse.

Thus, on the one hand, access to export capacity is key to the development of low cost, low impact high value water by the EWA. On the other hand, new export capacity under

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the control of the Projects represents both a degradation of the environmental baseline and a major new draw on limited EWA assets. This problem will only get worse if export demand rises in the future. Therefore EWA should control a major share of new export capacity, if not a share of existing capacity.

How to divide capacity? My initial thinking is based upon the following considerations:

- Avoid interfering with existing contractual rights as much as possible.
- The Projects currently control all existing export capacity.
- Increased export capacity provides limiting returns to the Projects. That is, the first kcfs of new capacity provides more benefits than the next kcfs etc.
- Increased export capacity probably causes accelerating damage to the environment. That is, the first kcfs of new capacity probably causes less damage than the next kcfs etc.
- Increased export demand causes new environmental damage.

Therefore, the EWA needs to receive an appreciable share of any new export capacity merely to be able to mitigate for the new damage caused by the higher pumping rates resulting from new infrastructure and increased demand. Then, if the EWA is to provide for environmental enhancement, it must receive an additional share. In an attempt to integrate all of these considerations, I created the following function:

EWA share of new export capacity = $(1-k)Q^2/Qmax + (2k-1)Q$

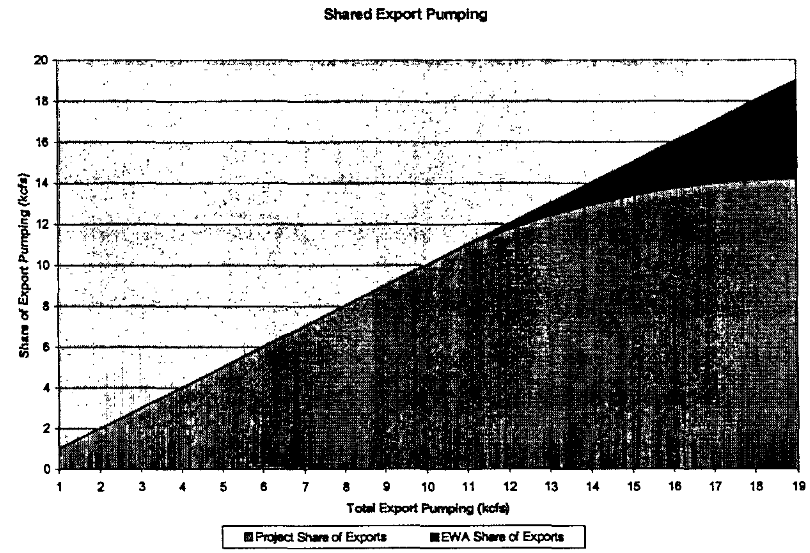
Where

k= Fraction of total new capacity going to EWA when capacity is at maximum
Q = Actual level of new export pumping (not total, just the new increment).
Qmax = Maximum level of potential pumping (if hydrology were favorable). Thus, for months when pumping into Delta islands is forbidden, Qmax would only reflect capacity at Banks and Tracy. Qmax would rise for months when Delta intakes are available.

The function would not apply to use of new export capacity for market transfers or storage transfers.

This function has the property that when Q = 0 (i.e., when no new pumping capacity is on line), the EWA share of pumping is 0. When Q = Qmax, then the EWA share of the new capacity = k, which, as I have said, should probably be > .5. When Q = Qmax, dE/dQ = 1. Thus, the Projects get the first increment of new capacity, the EWA gets the last.

If we set k = .6 and Qmax is 8 kcfs (e.g., a scenario where new Banks pumping and 4 kcfs of Delta island diversions were all potentially available) then we would get the following division of rights:



This function tends to meet the specifications I presented before. The Projects get most of the first increment of capacity. The EWA gets most of the last increment. The cost of driving exports down from very high levels (e.g., 19 kcfs) to lower levels (e.g., 14 kcfs) is relatively low, since the reduced pumping comes mostly out of lost EWA storage, not Project storage. As the Projects drive up exports to service increasing demands, they will automatically drive up EWA assets as well.

In my conception, the EWA would not be required to share capacity when pumping is above the E/I ratio (though a similar function could be written which gives the projects an increasing share of pumping as pumping rises above the E/I standard).

I propose that we run a future game using this kind of distribution of property.

Delta Storage and Water Quality

The water quality impacts of Delta storage has become a major question mark. Delta storage is clearly of great value to the EWA. However, the storage may be associated

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with high TOC, particularly if storage is tied directly into Clifton Court Forebay. (CCF) If we conclude that Delta storage connected to the CCF is a water quality problem, we have a number of possible responses:

- Seal the islands with clay.
- Dig out the peat. This has the added benefit of increasing storage potential, increasing the depth of storage, and providing fill for use in habitat restoration.
- Reduce residence time. We could generally evacuate the islands very quickly after filling.
- Deliver water only to meet agricultural demand on the DMC. This requires an intertie from Bacon/Victoria to Tracy and the O"Neal Bypass. The idea is to hold water until ag demand on the DMC is high enough to absorb all the capacity from Bacon/Victoria. Then, empty Bacon/Victoria solely for agriculture. Other federal pumping would be shifted to CCF using the JPOD. This would keep TOC out of urban water and would probably reduce salt loading for agricultural as well. It would constrain Bacon to filling only once per winter, however.
- A related idea would be to draw water out of Bacon and to release it into the Mendota pool during the salmon outmigration period to boost flows and to increase Delta outflow (or to be backed into upstream storage for the EWA). (This is like Alex Hildebrand's recirculation approach, but without rediversion at the bottom). This would, incidentally, reduce the need for the EWA to purchase water on the SJR for flows (unless there were specific tributary needs.). This is especially important if we have overestimated market water availability or underestimated the price. I guess, some of the TOC would get back into the Projects, but the water would be diluted, particularly during the VAMP period (with limited exports and closure of Old River). We could even think about an in lieu arrangement in which we supply the water in return for credit from the exchange contractors (thus allowing us to get some of the water back in the export area).
- A similar idea would be to use this water to make deposits into the Gravelly Ford groundwater site, again via the DMC. The TOC problem disappears, and we get long-term storage.

Project Benefits from EWA

The EWA appears to provide net water supply benefits to the Projects in two ways: though this statement still needs to be confirmed.

- First, there is the interaction between diversions and X2. My impression is that the EWA has tended to clip off high Delta outflows through increased diversions, and to increase Delta outflows at lower flow levels. Because the relationship between Delta outflow and the movement of X2 downstream is logarithmic, improvements in Delta outflow at low outflows have a much greater positive effect on X2 than reductions in outflow at high outflows. This could mean that the EWA is helping, on average, to meet the X2 standards through its operations. If so, then either the EWA should get credits for this water, or it needs to be added to estimates of improved project yield.
- Of course, if the opposite is true and the EWA is making compliance with X2 more difficult, then the EWA must compensate the Projects.
- Second, there is the issue of the San Luis low point. As I understand it, in most years, the Projects attempt to operate SLR such that minimum storage (in August) is greater than some specified amount. This carryover storage will constrain Project deliveries. **The existence of EWA water in San Luis in the late summer allows the Projects to deliver water below their previous low point.** Another way of putting it is that the EWA is providing the dead storage in San Luis, or that the Projects are borrowing EWA storage in San Luis. Now, the Projects will not necessarily gain water supply out of this maneuver. If San Luis doesn't fill and the EWA doesn't have storage in San Luis the next summer, the projects would have to reduce deliveries and would be right back where they started. But when SLR fills, the Projects will have increased their deliveries. This is just the opposite of demand shifting by EWA.

Accounting for Changed Operations

The first conclusion I draw is that the EWA requires multiple accounts – one for every reservoir in which it controls or owes water and perhaps others as well. The idea that EWA "credits" can simply be applied anywhere in the system simply cannot work. Water developed through increased exports cannot simply be transferred into an upstream reservoir without risk to those water users serviced by the reservoir. Therefore, the EWA needs multiple accounts, with the possibility of transferring water from one account to another if circumstances permit.

Up to now, we have relied upon a base model run for our accounting. When an EWA operation changed releases or diversions compared to the modeled rate, the EWA either gained or spent assets. In real operations, there is no baseline. Therefore, we need to develop a methodology for computing the degree to which EWA actions have increased or decreased releases and diversions.

There are several ways to proceed:

1. Develop an accurate model about how the Projects operate in real life, in real time. This model can then provide the basis for an accounting system.[2] I view this approach as infeasible.
2. Negotiate baselines as we go. The Projects will estimate what their operations would have been except for EWA involvement. We will then assess credits and debits based on how operations with EWA involvement differed from this baseline. This approach has been used with some success over the past several years. However, as the EWA begins to act more frequently, this approach runs into conceptual problems, since over time, the Project baseline will no longer represent Project operations without EWA,

[2] For example, a model might be based upon the assumption that: (1) The Projects always divert all the water they can at the first available opportunity and (2) The Projects always release the least amount of water they can while still satisfying downstream flow and water quality standards

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but rather Project operations in response to past EWA actions. This destroys the concept of the baseline. This approach has promise, but it needs modification.

3. The simplest approach will be to keep accounts, not on an instantaneous basis, but on a seasonal basis. If we can aggregate our accounts in this way, then we need not worry so much about instantaneous baselines, but can settle our accounts at the end of a season – e.g., at San Luis high point and low point.

Let me present how we might do the accounting for exports first. Then we can consider interactions with upstream storage.

- The computation of EWA export water asset gains should be straightforward. The EWA will acquire water in the export area by (1) granting an E/I variance, (2) using excess Project pumping capacity, (3) transferring water from upstream or from an export user, or (4) using export capacity which the EWA controls. In each of these cases, we should be able to compute how much export water is controlled by the EWA and we will know where in storage the water lies. We can also keep track of the way EWA assets in San Luis Reservoir may "spill" as San Luis fills. Once the sum of Project storage plus EWA storage in SLR reach maximum storage, EWA storage is diminished by the amount of pumping foregone by the Projects because they have no place to put the water.
- The computation of EWA export debits will be more difficult. We cannot simply count up export reductions demanded by the EWA or we may force the EWA to pay twice for the same water. I believe the solution lies in the assumption that the Projects will make every effort to fill San Luis Reservoir before the agricultural growing season. Therefore, each year, the EWA debt to the Projects in the export area would be calculated at the high point in San Luis Reservoir. The debt would be computed as:

  > Any carryover debt + the lesser of (1) the volume of Project exports which were foregone due to EWA action and (2) unused Project storage in SLR.

  The EWA would then be responsible for paying back this debt plus any debts incurred after high point,[3] before low point in SLR. Or the EWA could make arrangements with the Projects or other agency for carrying over debt past low point.

This approach has the advantage of freeing us from the burden of coming up with the baseline operations which would have existed *if EWA took no action to reduce exports.* We do need to estimate real time base operations (i.e., what would the Project have exported each day, given the existence of the EWA), but this should be relatively straightforward.

One possible weakness is that the Projects could conceivably modify Project operations in ways that create spurious EWA debts to the Projects by lowering high point storage in San Luis. For example, the Projects might shift water into some other reservoir. Or MWD might take early delivery of its water and hold the water in the East Side Reservoir. Similarly, in the drier years, the Projects could delay the transfer of storage from upstream reservoirs to San Luis. However, we should be able to handle these kinds of problems. Because the debt is the lesser of EWA reductions and unfilled SLR storage, this problem will only arise in years when San Luis would have filled, but for operational manipulations by the Projects to keep SLR from filling. Thus, holding water upstream during dry years is unlikely to be a problem. Moreover, we should be able to expand beyond SLR to include all south of Delta storage in our computations.

Upstream accounting is largely analogous to export accounting. The EWA may gain control over water in upstream storage by purchase, by backing up water from downstream, by exchange with the Projects, by developing water in EWA controlled storage, or by selective relaxation of instream flow standards (analogous to relaxing the E/I ratio). The EWA spends upstream water by releasing water above the flows that would otherwise occur, or by selling or exchanging the water. EWA water may spill if storage levels begin to intrude upon low priority EWA water. Again, the negotiation of a daily "baseline" will be needed in order to compute how much EWA is spent during release. Projects will frequently release water at minimum regulatory flows, but sometimes, they may release at higher levels in order to supply downstream demands or generate power.

Linkage of EWA to Water Quality

We have discussed the possibility that EWA might be given responsibility for improving export water quality. I believe that this would be a bad idea. With the EWA, we are giving empowering an environmental trustee to take discrete actions to achieve substantial environmental enhancement. We presume that the trustee will become very clever in pursuing the interests of its clients (the fish). Water agencies have always had this kind of discretion. If, now, we force the EWA to also attempt to enhance water quality, we confuse its mission with possibly conflicting goals. It may be appropriate to force the EWA to do no harm to water quality, on average. This would be in keeping with the "no harm" foundation of the EWA. A "no harm" requirement could be measured in terms of annual salt or TOC load, for example (but with the possibility that a reduction in salinity might compensate for an increase in TOC, and vice versa). The EWA could probably meet such a requirement without major gymnastics. To go further than this is to create managerial confusion about priorities.

Linkage to ERP Flows

CALFED is simultaneously proposing the creation of an EWA, and the purchase of $20 million worth of upstream flow enhancements. It makes no sense for these to be separate programs. The upstream flow enhancements are easily accomodated within the EWA approach and there should be substantial cost savings attached to considering Delta actions and upstream actions simultaneously. For example, upstream flow releases will frequently enhance Delta outflows, or could be pumped by the EWA in the Delta. Similarly, EWA export reductions may allow water to be backed up into upstream

[3] Debts incurred after high point do not risk being double counted and so can simply be tallied up on a daily basis.

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reservoirs, or EWA export water might be traded for upstream storage. Thus, there are substantial benefits to putting all flow related CALFED actions under the umbrella of the EWA.

Linkage to CVPIA b(1), b(2), and b(3) Water

This is a more sensitive topic, but the same logic applies to CVPIA environmental water. The b(1), b(2), and b(3) water in the CVPIA, taken together all have analogs within the EWA.

- b(1) water represents reoperation of the CVP to yield more environmental benefit without water purchases and without cost to the contractors. The EWA is capable of catalyzing the same operational changes through trades with the CVP.
- b(2) water represents the use of a sort of "property right" to enhance the environment. In this case, the property right is 800 kaf of CVP yield (as defined by deliveries during the canonical drought). The EWA is based upon the idea that environmental property rights can be deployed to protect the environment.
- b(3) water is water purchased to supplement needs not met by b(1) and b(2) water. The EWA also relies heavily upon water purchases.

There are differences, however, between the way that the CVPIA is being implemented and the way we envision the implementation of the EWA:

- CVPIA flow patterns have been based upon fixed AFRP flow targets – a set of quasi flow standards designed to help double anadromous fish. Unlike actions within the EWA, AFRP actions are fixed and are not to be altered in real time.
- Environmental rights to the b(2) water are not well defined. It is not clear whether the environment controls water itself, or whether the environment merely is able to force release of water to help meet AFRP flows (and thereafter loses any right to the water). For this reason, no accounting system has ever been developed to track environmental water and it is very difficult to control, manipulate and reuse b(2) water as is done by the EWA.
- Operational shifts for the environment are developed cooperatively by the USFWS and the CVP. The USFWS does not have the right to manage environmental water as it sees fit.

I would argue that, in general, the approach taken within the CVP to date is inferior to the proposed structure of the EWA in the following respects:

- The EWA is able to modify flow patterns in real time.
- The EWA has control of real assets – water, facilities, purchases. It is able to shift resources around in time and space to optimize protection. Thus, it is able to shift resources to a particular place or it can hold resources across years to focus protection on certain types of years.
- The EWA is able to act unilaterally – it does not need the permission of the Projects for many of its activities.
- Through its ability to provide collateral for proposed activities, the EWA should be able to gain Project approval for operational shifts that the Projects would never otherwise accept.

This suggests that CVPIA water and the EWA water should be merged under a single umbrella, with the overall administration similar to what is now proposed for the EWA. This would require that the CVPIA b(1), b(2), and b(3) authorities be converted into the asset-based approach of the EWA. There do not appear to be any major obstacles to this conversion:

- An EWA which incorporated CVPIA water would have the ability to implement b(1) type actions through agreements with the CVP.
- The b(2) water could be quantified and allocated to an EWA through a number of mechanisms. The simplest approach might be to allocate enough high priority storage in CVP facilities to an EWA to reduce CVP yield during the canonical dry period by 800 kaf. The EWA would control all water captured by this storage and could hold the water, release it, sell it, trade it, etc.
- The b(3) water simply represents funding available for all operations of the EWA, including purchase of water, storage, and conveyance.
- The AFRP "standards" would need to be softened to allow for some discretion on the part of the EWA to maximize benefits.

Given these modifications to the implementation of the CVPIA, the marriage of the CVPIA water and the EWA would be very powerful. The CVPIA would bring in enormous upstream assets into the umbrella. The CALFED portion of the new EWA would bring in new funding, rights to vary some SWRCB standards, and access to export pumping capacity.

A VAMP/ EWA Accounting Issue

The VAMP experiment calls for 30 days of export reductions in April and May, coupled with upstream flow releases to assist in the downmigration of San Joaquin salmon. The nominal starting time for the export reductions is April 15, though this can be changed, based upon evidence that salmon are moving down the rivers earlier or later than this date. Exporters have supported the experiment on the condition that all export reductions are paid back. The CVP portion of VAMP may be met using b(2) water (is this right?). My only point is that the starting date for the VAMP experiment has significant implications for export water impacts. In general, as VAMP is begun earlier in April, export impacts increase. This is a result of the natural tapering off in Delta flows over the spring. If the EWA is required to implement VAMP using its own resources, there is no accounting problem. However, if VAMP is treated as a standard with no payback required, then shifting the start date of VAMP will have variable impacts on the Projects. This could cause distortions in operating approaches. During the

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gaming, we have already seen the biologists move up the start date of VAMP in order to reduce costs to the EWA of paying for additional export reductions. I suggest that the EWA should either be made responsible for reimbursing the Projects for VAMP, or for reimbursing them for any additional costs caused by moving VAMP forward in time (plus receiving credits from the Projects for delaying VAMP).

Similarly, if an April 15 – May 15 experiment is enshrined as a standard and paid for

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